REMARKS

Claims 1-17 are pending in the application. Claims 1, 2 and 5 were rejected under 35 U.S.C. § 102(b) as described in paragraph 4 of the Office Action. Claims 3 and 4 were rejected under 35 U.S.C. § 103(a) as described in paragraph 6 of the Office Action. Claims 6-11 were rejected to as being dependent upon a rejected claim, but were indicated as being allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims, as discussed in paragraph 7 of the Office Action. Claims 1, 5 and 12 are the only independent claims.

The specification has been amended to place the application in correct idiomatic English and to correct a typographical error on page 7, line 23.

Claim 1 has been amended so as to require the pressure device to include a member for applying an upward force to the dresser to decrease the pressure during a dressing operation. Claim 5 has been amended to require the pressure being exerted by the dresser tool on the polishing surface to be based only on the weight of the dresser tool.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current Amendment. The attached page is captioned "**Version With Markings to Show Changes Made**". No new matter has been added.

Regarding paragraph 2 on page 2 of the Office Action, it is noted that Figures 1 and 2 have been described in the specification of the present application as "conventional;" they have not been described as "PriorArt". It has not yet been determined whether or not the subject matter disclosed in the present application as depicted in Figures 1 and 2 is prior art under U.S. law.

Applicants respectfully traverse the rejection of claims 1, 2 and 5 under 35 U.S.C. § 102(b), for the following reasons.

The present invention relates to a polishing apparatus for polishing a substrate, such as a semiconductor wafer. Specifically, the present invention relates to a polishing apparatus including a novel dresser device. A dresser device is used for regeneration of a polishing surface of a polishing pad or a polishing plate comprising abrasive particles. A conventional polishing apparatus is described in the present application, for example on page 1, line 10 through page 3, line 10. The

problem with the conventional polishing apparatus is that the weight of the dresser tool and the weight of the dresser shaft are both applied to the polishing pad during a dressing operation. Therefore, the polishing pad is scraped at a high rate, leading to a rapid wear of the polishing pad.

The present invention overcomes the problems associated with the conventional polishing apparatus. In accordance with a polishing apparatus of the present invention, the pressure between the dresser tool and the polishing surface of the turn table can be adjusted during a dressing operation. Therefore, dressing of a polishing surface can be conducted while suppressing a rapid wear of the polishing surface.

One aspect of the present invention prevents a pressure that corresponds to a weight that exceeds the weight of the dresser tool itself from being applied to the polishing surface. Therefore, dressing of a polishing surface can be conducted while suppressing a rapid wear of the polishing pad or plate. Further, in accordance with another aspect of the present invention, a dresser tool holding device supports the dresser tool in such a manner that the dresser tool is movable toward and away from the dresser tool holding device.

Independent claim 1 recites a polishing apparatus for polishing a substrate comprising a turntable, a substrate holder, a dresser, and a pressure device, "said pressure device including a member for applying an upward force to said dresser to decrease the pressure **during a dressing operation**."

Independent claim 5 recites a polishing apparatus comprising a turntable, a substrate holder, a dresser tool, and a dresser tool holding device for moving the dresser tool between a raised position and a dressing position "where said dresser tool rests on said polishing surface with a pressure being exerted by said pressure tool on said polishing surface **by only the weight of said dresser tool**."

Newly added independent claim 12 recites a polishing apparatus for polishing a substrate comprising a polishing surface, a substrate holder, a dresser, a dresser tool, and a dresser shaft, **wherein during a dressing operation, said dresser tool and said dresser shaft are arranged so as to be movable toward and away from each other**."

Hiyama fails to teach the above identified limitations. Hiyama discloses a polishing apparatus comprising a dressing head 8 that is coupled to a motor (not shown) and also to a lifting/lowering

cylinder (not shown). The dressing head 8 is vertically movable and rotatable about its own axis as indicated by arrows D, E by the motor and the lifting/lowering cylinder. As discussed in column 5, lines 7-13 of the reference, during a dressing process, the dressing element 9 which is held to the dressing head 8, is pressed to dress the polishing cloth 4 while a dressing liquid such as water is being supplied to the upper surface of the polishing cloth 4. In other words, during a dressing operation, the Hiyama apparatus applies a downward pressure towards the polishing cloth with the dressing head 8. The lifting/lowering cylinder is operable to lift and lower the dressing head 8. However, as depicted in Figure 2 of Hiyama, and discussed in column 5, lines 45-50, the dressing head 8 is not in contact with the polishing cloth 4 until the dressing operation starts at T1. At time T3, the dressing head 8 is lifted from the polishing cloth 4. Therefore, although at time T3, the dressing head of the reference is moved from the polishing cloth, time T3 does not occur during the dressing operation.

Accordingly, the apparatus of Hiyama fails to teach a pressure device including a member for applying an upward force to the dresser **to decrease the pressure during a dressing operation**, as required in amended claim 1. Therefore, Hiyama fails to teach every element of amended claim 1.

Furthermore, the dressing head 8 of Hiyama is integrally attached to the dresser shaft as depicted in Figure 1. Therefore, a total weight of the dresser head 8 and the dresser shaft will be applied to the polishing surface. In other words, Hiyama suffers from the same problems as the conventional polishing apparatus discussed for example on page 1, line 10 through page 3, line 10 of the present application. Accordingly, Hiyama fails to disclose that the shaft connected to the dressing head 8 moves the dressing head 8 to a dressing position where the dressing head 8 rests on the polishing surface with a pressure being exerted by the dressing head 8 on the polishing surface that is based only on the weight of the dressing head 8. Accordingly, Hiyama fails to teach a dresser tool holding device for moving a dresser tool to a dressing position where the dresser tool rests on the polishing surface with a pressure being exerted by the dresser tool on the polishing surface **by only the weight of the dresser tool**, as required in amended claim 5. Therefore, Hiyama fails to teach every element of amended claim 5.

Finally, as discussed above, the dressing head 8 of Hiyama is integrally connected to the dressing shaft, as depicted in Figure 1. Therefore, the dressing head 8 and the dressing head shaft are not arranged so as to be movable toward and away from each other. Therefore, Hiyama fails to teach

that **the dresser tool and the dresser tool shaft are arranged so as to be movable toward and away from each other** during a dressing operation, as required in newly added independent claim 12. Therefore, Hiyama fails to teach every element of newly added claim 12.

As anticipation under 35 U.S.C. § 102 requires that each and every element of the claim be disclosed in a prior art reference, *Akzo N.V. v. U.S. Int'l Trade Commission*, 808 F.2d 1471 (Fed. Cir. 1986), based on the foregoing, it is clear that Hiyama does not anticipate claims 1, 5 or 12. Furthermore, since claims 2-4, 6-11 and 13-17 are dependent upon claims 1, 5 and 12, respectively, and therefore include all of the limitations thereof, Applicants submit that claims 2-4, 6-11 and 13-17 additionally, are not anticipated by Hiyama.

In view of the above remarks, Applicants respectfully submit that claims 1, 2 and 5 are not anticipated by Hiyama, and urge that the rejection of claims 1, 2 and 5 under 35 U.S.C. § 102(b) be withdrawn.

Irrespective of the rejection of claims 3 and 4 under 35 U.S.C. § 103 as discussed in paragraph 6 of the Office Action, it is respectfully submitted that claims 3 and 4 are patentable for the reasons discussed above.

Having fully and completely responded to the Office Action, Applicants submit that all of the claims are now in condition for allowance, an indication of which is respectfully solicited.

If there are any outstanding issues that might be resolved by an interview or an Examiner's amendment, the Examiner is requested to call Applicants' attorney at the telephone number shown below.

Respectfully submitted,

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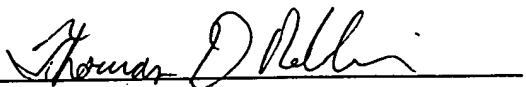
By: 

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April 8, 2002

pressure and a downward force to the dresser to increase the pressure.

By this arrangement, the pressure between the dresser tool and the polishing surface of the turntable can be adjusted to a level less than that generated by the weight of the dresser itself. Therefore, dressing of the polishing surface can be conducted while suppressing a rapid wear of the polishing surface.

The dresser may comprise a dresser shaft connected to the dresser tool and extending upward vertically from the dresser tool and the pressure device may comprise a cylinder equipped with a piston to which the dresser shaft is connected. A kinetic frictional resistance against movement of the piston in the cylinder is preferably 0.5 kg or less. First and second pressure supply devices may be fluidly connected to the cylinder so that the first pressure supply device supplies a pressurized fluid to the cylinder to apply an upward force to the piston and the second pressure supply device supplies a pressurized fluid to the cylinder to apply a downward force to the piston.

By preliminarily supplying a pressurized fluid to the above-mentioned cylinder so as to ~~cancel~~ counter the weight of the dresser out, the pressure between the dresser tool and the polishing surface of the turntable can be easily minimized to a level less than the weight of the dresser and adjusted to an arbitrary value exceeding that level (for example, a value in a range of 10 N to 300 N).

In accordance with another aspect of the present

Fig. 4 is a sectional view showing a dresser of a polishing apparatus in accordance with another embodiment of the present invention.

Fig. 5 is a sectional view showing a dresser of a polishing apparatus in accordance with a further embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Hereinbelow, description is made with regard to embodiments of the present invention, with reference to Figs. 3 to 5. In Figs. 3 through 5, the same portions as those in Fig. 1 or the portions corresponding to those in Fig. 1 are designated by the same reference numerals as used in Fig. 1.

Fig. 3 is a view showing an example of a general arrangement of a polishing apparatus of the present invention.

The polishing apparatus includes a turntable 1 with a polishing pad 2 provided on the upper side of the turntable 1, a substrate holder or wafer carrier 3, a dresser 4 and an air cylinder 9 for urging the dresser 4 against the polishing pad 2.

The air cylinder 9 is a low-friction type and the kinetic frictional resistance generated when a piston in the air cylinder 9 is moved is about 0.44 kg or less. Air is supplied through the controller 8 to the air cylinder 9 in a direction for moving the dresser 4 in a downward direction (a direction for pressing the polishing pad 2) and is supplied through a regulator 10 to the air cylinder 9 in a direction for moving the dresser 4 in an upward direction (a

direction for ~~canceling~~ countering the weight of the dresser out).

In this polishing apparatus, the weight of the dresser tool 5 and the weight of the dresser shaft 6 are set in the regulator 10 and air is preliminary supplied through the regulator 10 to the air cylinder 9 in an amount sufficient for ~~canceling~~ countering the weight of the dresser 4 out. Therefore, when no air is supplied through the controller 8 to the air cylinder 9, the pressure applied to the polishing pad 2 is zero. Consequently, by adjusting the amount of air supplied through the controller 8 to the air cylinder 9, the pressure applied to the polishing pad 2 can be adjusted to an arbitrary value between zero and a value larger than zero. That is, the pressure of the dresser tool 5 applied to the polishing surface of the polishing pad 2 can be minimized to a level less than the weight of the dresser tool 5 and can be adjusted to an arbitrary value exceeding that level.

As is described above, by supplying air through the regulator 10 to the air cylinder 9 in a direction opposite to the direction of air supplied through the controller 8, the weight of the dresser 4 is ~~canceled out~~ countered. In this case, however, the air cylinder 7 of a conventional type shown in Fig. 1 has a problem such that when the pressure applied to the polishing pad 2 is set to be low by the controller 8, it is difficult for an actual pressure applied to the polishing pad 2 to be precisely controlled due to a frictional resistance (slide resistance) of the air cylinder. This problem can be avoided by using the air cylinder 9 of a low-friction type having a frictional resistance of about 0.44

kg or less. By this arrangement, the minimum pressure applied to the polishing pad 2 can be set to a level as low as, for example, 10 N (Newton).

In Fig. 3, reference numeral 11 denotes a torque transmitting pin for transmitting a torque of the dresser shaft 6 to the dresser tool 5. Reference numeral 12 denotes a ball bearing for supporting the dresser tool 5 relative to the dresser shaft 6 in a manner enabling the dresser tool 5 to be inclined relative to the dresser shaft 6.

Fig. 4 shows a polishing apparatus in accordance with another embodiment of the present invention.

In this embodiment, a dresser tool 5 is connected to a dresser shaft 6 by torque transmission pins 11 in such a manner that the dresser tool 5 is movable relative to the dresser shaft 6 in a vertical direction, while the dresser tool 5 is rotated together with the dresser shaft 6. As shown, each torque transmission pin 11 extends through a vertical through hole formed in a flange 6a fixedly connected to the lower end of the dresser shaft 6 with a clearance being provided between the outer surface of the pin 11 and the inner surface of the vertical through hole of the flange 6a. The torque transmission pin 11 is provided at its upper end with a large diameter head 11a.

When the dresser shaft 6 is located at an elevated position, a lower surface of the pin head 11a is engaged with an upper surface of the flange 6a of the dresser shaft 6, whereby the dresser tool 5 is supported by the dresser shaft 6 in a suspended fashion.

WHAT IS CLAIMED IS:

1. A polishing apparatus for polishing a substrate comprising:

a turntable having a polishing surface;

a substrate holder for holding a substrate and bringing the substrate into contact under pressure with said polishing surface;

a dresser including a dresser tool adapted to be brought into contact under a pressure with said polishing surface to dress or condition said polishing surface; and

a pressure device connected to said dresser for moving said dresser between a raised position where said dresser is spaced away from said polishing surface and a dressing position where said dresser rests on said polishing surface such that said dresser tool is in contact with said polishing surface under only a pressure exerted by the weight of said dresser Tool ~~itself~~, said pressure device including a member for applying an upward force to said dresser to decrease the pressure.

2. A polishing apparatus as set forth in claim 1, wherein said dresser further comprises a dresser shaft connected to said dresser tool and extending upward vertically from the dresser tool, and said pressure device comprises a cylinder equipped with a piston to which said dresser shaft is connected.

3. A polishing apparatus as set forth in claim 2 wherein a kinetic frictional resistance against movement of said piston in said cylinder is 0.5 kg or less.

4. A polishing apparatus as set forth in claim 3 wherein there are provided first and second pressure supply devices fluidly connected to said cylinder so that said first pressure supply device supplies a pressurized fluid to said cylinder to apply said upward force to said piston and said second pressure supply device supplies a pressurized fluid to said cylinder to apply said downward force to said piston.

5. A polishing apparatus comprising:

a turntable having a polishing surface;

a substrate holder for holding a substrate and bringing the substrate into contact under pressure with said polishing surface;

a dresser tool adapted to be brought into contact under pressure with said polishing surface to dress or condition said polishing surface; and

a dresser tool holding device for holding said dresser tool and moving said dresser tool between a raised position where said dresser tool is spaced away from said polishing surface and a dressing position where said dresser tool rests on said polishing surface with a pressure being exerted by said dresser tool on said polishing surface as a result of the sole weight of said dresser tool ~~itself~~.

6. A polishing apparatus as set forth in claim 5 wherein said dresser tool holding device supports said dresser tool in such a manner that the dresser tool is substantially freely movable in a vertical direction relative to said dresser holding device.

7. A polishing apparatus as set forth in claim 6 wherein